Research Article

Quality Aspects of the Sudanese Fermented Milk (Robe) Supplemented with Gum Arabic powder

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ABSTRACT: Robe is the major fermented milk product in the Sudan. It is mainly produced from surplus milk and its consumption is part of Sudanese culture. The objective of this study was to use gum Arabic as stabilizer in production of the Sudanese fermented milk, Robe. Four types of Robe were prepared: control Robe was prepared using previous batch of Robe (2.5%), gum Robe using three levels of gum powder 5%, 7.5% and 10%. The analysis indicated that there were no noticeable change in the chemical components of Robe supplemented with 5% and 7.5% gum powder compared with the control Robe. However, the protein content of control sample (2.37%) was higher than that of Robe supplemented with 10% gum Arabic (1.78%). The total soluble solids (T.S.S) were highly increased from 8.92% in the control sample to 16.41% in 10% gum Robe. Moreover, the addition of gum powder resulted in decreasing the moisture content from 91.68% (control Robe) to 83.76% (10% gum Robe), and relative increasing of the ash content from 0.66% in the control Robe to 0.91% in 10% gum Robe. Moreover, the whey separation decreased with the addition of gum (5.67 ml for control) and (1.55 ml for 10% gum Robe). The sensory evaluation indicated acceptance of Robe prepared by adding gum powder due to the improvement of Robe texture.

Key words: Food, pastoralists, lactose, texture, flavor.

INTRODUCTION

Fermented milk products are known for their taste, nutritive value and therapeutic properties. Fermented milk are products prepared from milks, whole, partially or fully skimmed, concentrated or milk substituted from partially of fully skimmed dried milk, either homogenized or non-homogenized, pasteurized or sterilized and fermented by means of specific microorganisms (Kroger et. al., 1989).

The available estimate of milk production in the Sudan varies widely and no accurate statistics are kept. The (A.O.A.D, 2002) gave an estimate of annual milk production of 20249.91 million tons obtained from cow, goat, sheep and camel.

Robe is the major fermented milk product in the Sudan. It is mainly produced from surplus milk of the rainy season by nomadic tribes. About 80% of the rainy season milk is turned into Robe by the household in this season. The milk turned into dairy products in Sudan as reported by the Arab Organization for Agricultural Development (AOAD, 1983), is 65% of the total annual. Dirar (1993) gave an estimate of 50 – 60%. Robe makes about 90% of all fermented milk products. The aim behind the souring of milk into Robe is not to obtain fermented milk for consumption. Milk souring here is only an expedient to facilitate the extraction of butter from it. Therefore it is considered as a by-product of butter production. Pastoralists commonly waste Robe away by spillage on the ground or give it to dogs or young animals and wild birds. Nonetheless they daily consume part of it in one form or another. Robe fermentation is not then a way of preserving the essential part of the milk, and that is butter, as far as the nomads are concerned. Every few days the accumulated butter is boiled to give ghee or butteroil, called Samin. The unboiled butter or furssah finds no other use except that part of it is fed to babies. All other fermented dairy products of the Sudan are fermented to be consumed without removing the butter in advance (Dirar, 1993).

Gum Arabic is a dried exudation obtained from the stems of a Acacia senegal L. and well-related species. It consists
mainly of salts of acidic arabinogalacton protein complex which on hydrolysis yields glucose, arabinose rhamnose and glucuronic acid. The gums have two major properties gelling and thickening, all gums by definition have a thickening effect. This property is the basis for their use as bodying, stabling and emulsifying agents in many foods (Karamalla, 1999).

There is little or no-degradation of gum Arabic by micro organisms this characteristic is of great importance in food industries (Awad Elkariem, 1994).

Gum Arabic has been used as a stabilizer in frozen products such as ice-cream, ice milk, ice pop, and water-ice, because of its water-absorbing properties, it has also been used in chocolate, milk drink, pudding, cottage cheeses, cream cheese, cheese spread and yoghurt (Karamalla, 1999).

The objectives of the present study include: use Gum Arabic as a stabilizer in production of the Sudanese fermented milk product *Robe*, assess the chemical composition of the product and to determine the sensory evaluation of the product.

**Materials and methods**

**Materials**

Fresh cow's milk was obtained from local farm in El sinat , Wadmedani city, Sudan at early in the morning immediately after milking operation during march 2012 transported in sterilized container to the dairy laboratory of the department of food science and technology , university of gezira for further processing and analysis.

**Robe preparation**

Fresh milk sample was collected immediately after milking in plastic containers and was inoculated with starter (2.5%) of previously prepared *Robe*. Then the product was incubated over night at 37 °C and cooled to 6 °C, and then the resultant sour milk was churned to remove butter. The *Robe* was obtained after churning and removing the butter, then the gum was added at 5%,7.5% and10% concentrations and stored at a refrigerator for 1 , 7 , and 14 days .

**Methods**

**Chemical analysis of mish samples**

The chemical analyses were carried out in all *Robe* samples to determine the pH values and the contents of titratable acidity (TA) , ash, protein, total soluble solids (TSS), moisture, lactose and fat according to AOAC (1990,2000) methods, while whey separation was evaluated by taking 25 ml sample into filter paper with a funnel, and then put in scale cylinder for 2 hours at 6°C to measure the filtered whey.

**Sensory evaluation of Robe**

All types of *Robe* were subjected to sensory evaluation using 10 panelists at the first day of storage, the storage temperature was 6°C .The panelists were asked to rank the samples for color and appearance, texture, flavor and overall acceptability using 9 points hedonic scale with 1 as extremely bad score and 9 as the excellent, for these evaluation a special testing area was used so that distractions can be minimized and conditions can be controlled .The testing room was quiet ,comfortable environment with uniform level of lighting and good ventilation ,each panelist was provided with water for rinsing .All these conditions were equalized for all tests ,the samples were given codes before being tested  and randomized for each panelist ,all these conditions and treatments were applied at second and third week of storage.

**Statistical analysis**

All scores of the sensory evaluation were analyzed by the analysis of variance (ANOVA), to determine whether there were significant differences between means for each variable, the least significant difference (LSD) test was used .
Table 1. Chemical composition of control Robe and Robe samples supplemented with gum powder during storage period

<table>
<thead>
<tr>
<th>Robe/Storage Period</th>
<th>pH</th>
<th>Acidity%</th>
<th>Protein%</th>
<th>Moisture%</th>
<th>TSS%</th>
<th>Lactose%</th>
<th>Ash%</th>
<th>Fat%</th>
<th>Whey ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day A</td>
<td>4.04</td>
<td>1.85</td>
<td>2.85</td>
<td>91.33</td>
<td>8.65</td>
<td>4.34</td>
<td>0.78</td>
<td>0.95</td>
<td>4.05</td>
</tr>
<tr>
<td>7 days A</td>
<td>3.74</td>
<td>2.51</td>
<td>2.23</td>
<td>91.77</td>
<td>8.21</td>
<td>4.19</td>
<td>0.55</td>
<td>0.58</td>
<td>6.00</td>
</tr>
<tr>
<td>15 days A</td>
<td>3.87</td>
<td>2.23</td>
<td>2.04</td>
<td>91.97</td>
<td>8.01</td>
<td>3.96</td>
<td>0.54</td>
<td>0.35</td>
<td>6.95</td>
</tr>
<tr>
<td>1 day B</td>
<td>4.01</td>
<td>1.67</td>
<td>2.45</td>
<td>87.60</td>
<td>12.34</td>
<td>4.81</td>
<td>0.91</td>
<td>0.90</td>
<td>2.70</td>
</tr>
<tr>
<td>7 days B</td>
<td>3.74</td>
<td>2.50</td>
<td>1.95</td>
<td>88.04</td>
<td>11.93</td>
<td>4.37</td>
<td>0.82</td>
<td>0.55</td>
<td>3.95</td>
</tr>
<tr>
<td>15 days B</td>
<td>3.93</td>
<td>2.06</td>
<td>1.57</td>
<td>88.38</td>
<td>10.93</td>
<td>3.90</td>
<td>0.65</td>
<td>0.30</td>
<td>5.00</td>
</tr>
<tr>
<td>1 day C</td>
<td>4.11</td>
<td>1.55</td>
<td>2.27</td>
<td>85.72</td>
<td>14.26</td>
<td>4.73</td>
<td>0.90</td>
<td>0.85</td>
<td>1.20</td>
</tr>
<tr>
<td>7 days C</td>
<td>3.71</td>
<td>2.53</td>
<td>1.96</td>
<td>85.86</td>
<td>12.33</td>
<td>4.28</td>
<td>0.82</td>
<td>0.45</td>
<td>2.50</td>
</tr>
<tr>
<td>15 days C</td>
<td>3.95</td>
<td>1.89</td>
<td>1.33</td>
<td>86.86</td>
<td>11.71</td>
<td>3.90</td>
<td>0.75</td>
<td>0.30</td>
<td>4.10</td>
</tr>
<tr>
<td>1 day D</td>
<td>4.15</td>
<td>1.51</td>
<td>2.18</td>
<td>83.33</td>
<td>16.63</td>
<td>4.78</td>
<td>0.98</td>
<td>0.80</td>
<td>0.75</td>
</tr>
<tr>
<td>7 days D</td>
<td>3.68</td>
<td>2.55</td>
<td>1.85</td>
<td>83.95</td>
<td>16.53</td>
<td>4.28</td>
<td>0.96</td>
<td>0.40</td>
<td>1.05</td>
</tr>
<tr>
<td>15 days D</td>
<td>3.96</td>
<td>2.09</td>
<td>1.32</td>
<td>84.01</td>
<td>15.96</td>
<td>3.70</td>
<td>0.79</td>
<td>0.30</td>
<td>2.85</td>
</tr>
</tbody>
</table>

A: control Robe sample; B: Robe with 5% gum powder; C: Robe with 7.5% gum powder; D: Robe with 10% gum powder.

Results and Discussion

In the present study, Robe supplemented with gum Arabia product prepared at laboratory level. This product was evaluated by chemical and sensory methods. Generally, there were no noticeable change in most of the chemical components of Robe supplemented with low levels of gum powder compared with the control Robe. However, the sensory analysis indicated acceptance of gum Robe.

Chemical analysis

The data in Table 1 shows the effect of storage on the control Robe compared to Robe samples supplemented with gum powder at 5, 7.5 and 10% levels. All types of Robe samples were stored at 6 °C for 1, 7 and 15 days. The average pH decreased during fermentation, the average pH of control sample after one day of storage was 4.04 which was relatively higher than that reported by Sulieman (2001) who reported a value 3.90 in Barakat Robe sample and lower than that of yoghurt (4.4%) as reported by Mahgoub (2010), however, Robe supplemented with 7.5 and 10% gum powder had pH values of 4.11, 4.15, respectively. The reduction in pH continued until the 7th day of storage in the control Robe sample (3.74), this result was slightly lower than that reported by Sulieman (2001) who reported a value 3.78, and closely related to those of Robe samples supplemented with 5, 7.5 and 10% gum powder which averaged 3.74, 3.71 and 3.68 respectively. However, after 15 days of storage, the pH of control Robe sample gradually increased with an average of 3.87, and this result was slightly lower than that reported by Mahgoub (2010) in control yoghurt sample at 15 days of storage which was 4.0±0.06%.

Titratable acidity of Robe (expressed as lactic acid%), increased by fermentation, the rate of increase in the control Robe sample after one day of storage was 1.85%, which was lower than that reported by Abbas (2005) who reported a value of 1.50 % titrable acidity in cows traditional yoghurt. However, control Robe sample had higher titratable acidity compared with Robe samples supplemented with the three levels of 5%, 7.5% and 10% which averaged 1.66%, 1.55% and 1.51%, respectively. The increase in acidity continued until the 7th day of storage in control Robe sample with an average of 2.51%. The increase was also noticed in the three types of Robe samples supplemented with 5, 7.5, and 10% gum powder with an average of 2.50%, 2.53% and 2.55%, respectively. In 15th day of storage, the titratable acidity values started to decrease in the control Robe sample with an average of 2.23%. In all samples of Robe there were an increase in acidity and decrease in pH values until 7 days of storage time, however, after 15 days of storage the acidity slightly decreased and pH values increased and this result may be due to the action of microorganisms dominant in Robe.

The moisture content in control Robe sample after one day of storage was 91.33% and this value was higher than those found in Robe sample supplemented with 5%, 7.5% and 10% gum powder which were 87.60%, 85.72% and 83.33%, respectively, and higher than that reported by Mahgoub (2010) in control yoghurt sample which was 84.9%, 0.71%. The moisture content of control Robe sample increased after 7 and 15 days of storage to 91.77% and 91.97%, respectively. The increase of moisture content may be due to high free water content of control Robe sample. Similarly
the moisture content of Robe supplemented with 5.7.5 and 10% gum powder continued to increase after 7 and 15 days of storage with an average of 88.04%, 85.86% and 83.95%, respectively. However, after 15 days the moisture values reached 88.38%, 86.86% and 84.01% respectively.

The total solids (TSS) content of control Robe sample after one day of storage was 8.65%, this value is higher than that reported by Sulieman (2001), who reported a value of 7.80% in laboratory-made Robe and 7.50% in Barakat Robe, and lower than that reported by Mahgoub (2010) for control yoghurt (15.1%+0.05%). The TSS of Robe samples supplemented with gum powder which ranged 12.34%-16.63%. The TSS of control Robe samples slightly decreased after 7 and 15 days of storage, this reduction may be attributed to the higher moisture content as well as the hydrolysis of lactose to lactic acid (as a result of the action of microorganisms). Similarly, in Robe samples supplemented with gum powder, TSS% continued to decrease during storage time to 11.93%, 12.33% and 16.53%, after 15 days of storage the values reached 10.93%, 11.71% and 15.96% in Robe supplemented with 5%, 7.5% and 10% gum powder, respectively.

The protein content of control Robe sample after one day of storage has an average of 2.85%, this value was lower than that reported by Sulieman (2001) who reported a value of 4.2% in laboratory-made Robe and 3.96% in Barakat Robe. The protein content of control Robe was slightly higher than those of Robe samples supplemented with 5%, 7.5% and 10% gum powder which were 2.45%, 2.27% and 2.18%, respectively. The protein content of control Robe samples decreased after 7 days to 2.23%. On the other hand, the value of protein content of Robe samples supplemented with 5%, 7.5% and 10% gum powder decreased after 7 days to 1.95%, 1.96% and 1.85%, respectively. This decrease in protein content continued to the 15th day of storage and reached 1.57%, 1.33% and 1.32% in Robe samples supplemented with 5%, 7.5% and 10%, respectively and 2.04% in the control Robe sample. The decrease in protein content of the Robe sample supplemented with gum powder may be attributed to the microorganisms present in gum Robe which may hydrolyzes the protein to amino acids and peptides and utilize them as nutrients.

The ash content of control Robe sample after one day of storage was 0.78%, this value was lower than the values of Robe samples supplemented with 5, 7.5, and 10% gum powder which averaged 0.91%, 0.90% and 0.98%, respectively. This ash value was higher than the value of traditional yoghurt (0.66% as reported by Abbas (2005). However, after 7 days of storage ash content of control Robe sample decreased to 0.65% and the reduction continued until the 15th day of storage with an average of 0.54%. This reduction could be due to the effect of microorganisms on some minerals. On the other hand the ash content of Robe supplemented with 5%, 7.5% and 10% gum powder decreased after 7 days with an average of 0.82%, 0.82% and 0.96%, respectively. This decrease continued after 15 days of storage to 0.65%, 0.75% and 0.79%, respectively. However, the ash content of Robe samples increased with increasing contents of added gum powder, this may be attributed to the presence of some minerals in the gum like calcium at high concentration.

The lactose content of control Robe sample after one day of storage was 4.34%, this value was slightly lower than that reported by Sulieman (2001) who reported a value of 4.40% in Barakat Robe and 4.50% in laboratory-made Robe. The lactose content of control sample was lower than those of Robe samples supplemented with 5%, 7.5% and 10% gum powder which averaged 4.81%, 4.73% and 4.78%, respectively.

The higher lactose content in the gum Robe sample may be due to the presence of polysaccharides in the gum. Lactose content of control Robe decreased after 7th day to 4.19%. On the other hand, the value of lactose content of Robe supplemented with 5%, 7.5% and 10% gum powder also decreased after 7 days of storage with an average of 4.37%, 4.28% and 4.28%, respectively. This decrease in lactose content continued until the 15th day of storage and reached 3.96% in the control Robe sample and 3.90%, 3.90% and 3.70% in Robe supplemented with 5%, 7.5% and 10% gum powder, respectively. However, the ash content of Robe samples was reduced with the increase of storage period due to conversion of lactose to lactic acid.

The fat content of control to conversion of lactose to lactic acid after one day of storage was 0.95%, this value was slightly higher than those of Robe supplemented with 5%, 7.5% and 10% which averaged 0.90%, 0.85% and 0.80%, respectively. The fat content of control Robe sample highly decreased after 7 days of storage with an average of 0.55%, moreover, in Robe supplemented with 5%, 7.5% and 10%, the fat content was 0.55%, 0.45% and 0.40%, respectively. This decrease continued until the 15th day of storage in the control Robe to 0.35% and 0.30% in all gum Robe samples. The reduction of fat content during storage period could be attributed to the action of microorganisms.

The amount of whey separated after one day of storage from the control Robe sample averaged 4.05 ml, this amount was higher than those of Robe supplemented with 5, 7.5 and 10% which were 2.70 ml, 1.20ml and 0.75 ml, respectively. However, after 7 days of storage, the amount of whey increased to 6.00 ml in control Robe sample. Similarly the amount of whey increased after 7 days of storage in Robe supplemented with 5, 7.5 and 10% gum powder to 3.95 ml, 2.50 ml and 1.05 ml, respectively. The increase was continued until the 15th day of storage and reached 6.95ml in control Robe sample. The increase in whey separation may be attributed to free water and reduction of pH. Generally, The control Robe sample have amount of whey higher than those of gum Robe samples.

The statistical analysis showed that there was no significant difference (P > 0.05) in pH, acidity, lactose and fat between the control Robe sample and gum Robe samples. However, there were highly significant differences (P < 0.01) in protein, moisture, TSS, Ash and whey separation between control Robe samples and gum Robe samples (Table 2).
Table 2. Statistical analysis of chemical composition of control robe and robe samples supplemented with Gum powder

<table>
<thead>
<tr>
<th>Samples</th>
<th>pH</th>
<th>Acidity</th>
<th>Protein</th>
<th>Moisture</th>
<th>Lactose</th>
<th>TSS</th>
<th>Ash</th>
<th>Fat</th>
<th>Whey ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.882</td>
<td>2.193</td>
<td>2.370</td>
<td>91.68</td>
<td>4.163</td>
<td>8.290</td>
<td>0.655</td>
<td>0.617</td>
<td>5.667</td>
</tr>
<tr>
<td>B</td>
<td>3.880</td>
<td>2.068</td>
<td>1.990</td>
<td>88.003</td>
<td>4.355</td>
<td>11.732</td>
<td>0.791</td>
<td>0.683</td>
<td>3.883</td>
</tr>
<tr>
<td>C</td>
<td>3.920</td>
<td>1.987</td>
<td>1.853</td>
<td>85.745</td>
<td>4.300</td>
<td>12.765</td>
<td>0.823</td>
<td>0.533</td>
<td>2.600</td>
</tr>
<tr>
<td>D</td>
<td>3.930</td>
<td>2.048</td>
<td>1.782</td>
<td>83.763</td>
<td>4.252</td>
<td>16.412</td>
<td>0.912</td>
<td>0.500</td>
<td>1.550</td>
</tr>
</tbody>
</table>

Level of significance: NS: no significant differences, **: highly significant differences

Table 3. Mean scores for sensory evaluation characteristics of gum robe during storage

<table>
<thead>
<tr>
<th>Sample</th>
<th>1 day</th>
<th>7 day</th>
<th>14 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Color</td>
<td>Texture</td>
<td>Flavor</td>
</tr>
<tr>
<td>A</td>
<td>7.62 a</td>
<td>5.25 a</td>
<td>6.75 a</td>
</tr>
<tr>
<td>B</td>
<td>6.62 ab</td>
<td>6.88 b</td>
<td>6.50 a</td>
</tr>
<tr>
<td>C</td>
<td>6.12 abc</td>
<td>7.38 bc</td>
<td>6.62 a</td>
</tr>
<tr>
<td>D</td>
<td>4.75 c</td>
<td>8.25 c</td>
<td>6.62 a</td>
</tr>
</tbody>
</table>

Probability Level of significance: *: Significant differences, **: Highly significant differences

Sensory evaluation

The result of sensory evaluation (Table 3) indicates that there were no significant differences (P<0.05) in flavor between the control robe and gum robe samples during the entire storage time. And there was significant difference (P< 0.05) between the samples in the colour at the first day and 7th days of storage since the panelists mostly preferred white color which exists in control robe sample. However, there was no significant difference between control robe and gum robe samples in the color at the 15th day of storage. On the other hand there was a highly significant difference (P< 0.01) in the texture between control sample and the other samples at 1 day and 7 days of storage. However, there was significant difference (P< 0.05) between the control sample and gum robe samples in the texture at the 15th day of storage. Panelists gave high scores of texture to robe prepared using 10% gum powder. There were significant differences (P< 0.05) in overall acceptability between control and other samples at the first and 7th day of storage.

CONCLUSION

In the present study the investigation of chemical analysis and sensory evaluation of the Robe produced using gum powder with three levels (5%, 7.5% and 10%), in addition, control Robe which was prepared without addition of gum. All samples were stored at 6°C for 1, 7 and 15 days, the chemical analysis showed that there were decreases in protein, moisture, fat, acidity and whey separation for Robe supplemented with gum powder, and increases in contents of ash, lactose, T.S.S and pH. After 7 days of storage most of the chemical components of Robe gradually decreased and the reduction continued until 15th day of storage. The sensory evaluation of Robe produced using gum powder showed good results regarding to texture and overall acceptability than that produced without addition of gum powder (control yoghurt).
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